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What Is Consciousness?

Artificial Intelligence, Real Intelligence, Quantum Mind, And *Qualia*

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Abstract

We approach the question, "What is Consciousness?" in a new way, not as Descartes' "systematic doubt", but as how organisms find their way in their world. Finding one's way involves finding possible uses of features of the world that might be beneficial or avoiding those that might be harmful. "Possible uses of X to accomplish Y" are "Affordances". The number of uses of X is indefinite, the different uses are unordered and are not deducible from one another. All biological adaptations are either affordances seized by heritable variation and selection or, far faster, by the organism acting in its world finding uses of X to accomplish Y. Based on this, we reach rather astonishing conclusions: 1) Strong AI is not possible. Universal Turing Machines cannot "find" novel affordances. 2) Brain-mind is not purely classical physics for no classical physics system can be an analogue computer whose dynamical behavior can be isomorphic to "possible uses". 3) Brain mind must be partly quantum – supported by increasing evidence at 6.0 sigma to 7.3 Sigma. 4) Based on Heisenberg's interpretation of the quantum state as "Potentia" converted to "Actuals" by Measurement, a natural hypothesis is that mind actualizes Potentia. This is supported at 5.2 Sigma. Then Mind's actualization of entangled brain-mind-world states are experienced as qualia and allow "seeing" or perceiving" of uses of X to accomplish Y. We can and do jury-rig. Computers cannot. 5) Beyond familiar quantum computers, we consider Trans-Turing-Systems.

Keywords: Affordances, Universal Turing Machines, analog computers, classical physics, quantum mechanics, Strong AI, Potentia, Actuals, classical neurodynamics, quantum computing, dynamical criticality, soft matter,Trans-Turing-Systems.

I. **Introduction: The Issues**

This short paper makes four major claims: 1) Strong AI is not possible 2) Brain-mind is not purely classical. 3) Brain-Mind Must be Partly Quantum. 4) Qualia are experienced and arise with our collapse of the wave function.

These are quite astonishing claims. Even the first claim is major. Artificial Intelligence has been with us since Turing invented his Universal Turing Machine that refigures the globe. We await replacement by Siri and Borgs.

We hope to show this first claim is wrong for wonderful and fundamental reasons. The becoming of any world with an evolving biosphere of philosophic zombies, let alone conscious free will agents, is, remarkably, beyond any mathematics we know.

The pathway to this insight depends upon a prior distinction between the degrees of freedom in physics and in an evolving biosphere. In physics, the degrees of freedom include position and momentum, energy and time, the U(3)U(2)U(1) group structure of particle physics, the Schrödinger equation, General Relativity and Dreams of a Final Theory.

Oddly, in the evolving biosphere, "affordances" are the degrees of freedom. An "Affordance" is "The possible use of X to accomplish Y." Gibson, (1), points out that a horizontal surface affords a place to sit. In evolution, an existing protein in a cell used to conduct electrons also affords a structure that can be used as a strut in the cytoskeleton or bind a ligand. Evolution proceeds by organisms "stumbling upon ever new affordances and 'seizing' them by heritable variation and natural selection". "Evolution tinkers together adaptive contraptions", as F. Jacob said (2).

We humans do the same thing when we tinker and jury-rig. Given a leak in the ceiling, we cobble together a cork wrapped in a wax-soaked rag stuffed into the hole in the ceiling and held in place with duct tape (3).

Jury-rigging uses subsets of the causal features of each object that articulate together to solve the problem at hand. Any physical object has alternative uses of diverse causal features. An engine block can be used to drill holes to create cylinders and craft an engine, can be used as a chassis for a tractor, can be used as a paper weight, or its corners can be used to crack open coconuts (4).

It is essential that there is *no deductive relation*between these uses. And there is, therefore, *no deductive theory of jury-rigging* (ibid).

How many uses of a screwdriver alone or with other things exist? Is the number exactly 16? No. Is the number infinite? How would we know? How define? No, the number of uses of a screwdriver alone or with other things is *indefinite* (3,4).

Consider some uses of a screwdriver alone or with other things. Screw in a screw. Open a can of paint. Scratch your back. Wedge a door closed. Scrape putty off the window. Tie to a stick and spear a fish. Rent the spear and take 5% of the catch...

What is the relation between these different uses? There are four mathematical scales, nominal, partial order, interval, ratio. The different uses of a screwdriver are merely a *nominal* scale. There is *no ordering relation* between the different uses of a screwdriver (3,4).

II. **We cannot use mathematical set theory with respect to affordances.**

The Axiom of Extensionality: "Two sets are identical if and only if they have the same members." But we cannot prove that the indefinite uses of a screwdriver are identical to the indefinite uses of an engine block. No Axiom of Extensionality.

We cannot get numbers. One definition of the number "0" is "The set of all sets that have no element." This would be the set of all objects that have exactly 0 uses. Well, No. We cannot get the integers this way. We cannot get the number 1, or the number 17.

The alternative definition of numbers is via the *Peano axioms. Define a null set, and a successor relation, N and N+1.*But we cannot have a null set. And the uses of objects are *unordered*. There is *no successor relation*. We cannot get numbers from Peano. No integers, no rational numbers, no equations $2 + 3 = 5$. No equations with variables $3 + x = 5$. No irrational numbers. No real line. No equations at all. No imaginary numbers and no complex plane. No manifolds. No differential equations. No topology. No combinatorics and no first order predicate logic. No Quaternions, no Octonions. No "Well Ordering" so no "Axiom of Choice" so no taking limits, (4).

The implication is that *no Universal Turing Machine operating algorithmically,* hence *deductively* on 1 and 0, can find new affordances not already in its ontology of a finite set of objects and for each a fixed set of properties. The central reason is that there is *no deductive relation* between the indefinite uses of an engine block as a paperweight and to crack open coconuts.

If by Strong AI we mean the capacity of a universal Turing Machine to invent that which is not deductively derivable from its current ontology of objects and for each a fixed finite set of properties, Strong AI is ruled out.

Computers cannot jury-rig in novel ways. The evolving biosphere can and does jury rig in ever- creative ways by jury-rigged Darwinian Pre-adaptations such as the evolution of the swim bladder from the lungs of lungfish (3). Cells do thermodynamic work to *construct themselves*, (5). *The evolution of the biosphere is a progressive jury-rigged construction not an entailed deduction.(3, 4)* The evolution of hominid technology for the past 2.6 million

years is also one of unending non-deductive jury rigging, ten stones 2.6 million years ago exploding to billions of goods including the space station today, (5).

Life and mind are not algorithms. Siri and cyborgs will not replace us.

We can *just see or perceive* affordances. We can see and laugh about using an engine block as a paper weight and also to crack open coconuts. *Thus, we are not merely disembodied Universal Turing Machines.*

Again, Strong AI, or General AI, is ruled out.

But we do perceive affordances? How can we possibly perceive or "see" Affordance?

III. **Perhaps we are classical analogue computers**?

These classical analogue computers can be embodied as robots. Analog computers compute by being isomorphic to that that which is modeled. But we cannot be classical analog computers. The reason is unexpected: Affordances are "possible uses of X to do Y". But these *Possibles are ontologically real.* Before the evolution of the swim bladder from the lungs of lungfish was it *possible* that such a preadaptation would occur? Of course, the swim bladder really did come to exist. But what is the ontological status of this *Possible*? *The possibility is ontologically real***,** *as demonstrated by the subsequent fact that the swim bladder did come to exist, but it might not have come to exist. To "exist or not exist" is surely ontological!* Five hundred thousand years prior to the evolution of the swim bladder there was "no fact of the matter" concerning whether it might or might not emerge. C.S. Pierce pointed out that *Actuals obey Aristotle's law of the Excluded Middle.* "X is simultaneously true and not true", is a contradiction. All of classical physics obeys the law of the excluded middle. *Possibles do not obey the law of the excluded middle*. "X is simultaneously possibly true and possibly false" is not a contradiction (3).

In evolution, affordances are about *ontologically real "possible uses of X to do Y"*. This is also true in our seeing affordances in our immediate world. It is really true that it is possible to use the corners of an engine block to crack open coconuts. In technological evolution it is really true 5000 years ago that the cross bow might or might not come to exist. Five thousand years ago there was "no fact of the matter" concerning whether or not the cross bow might come to exist.

Astonishingly, this implies that no classical system can be an analogue computer for affordances. Affordances do not obey the law of the excluded middle, but all classical systems do obey that law. Thus, ***no classical system can be isomorphic to, hence model, affordances***.

The claim that no classical system can be an analogue model isomorphic to affordances

seems to be new and must survive severe critique.

IV. **Brain-Mind is Quantum.**

This hypothesis is widely discussed (6). We wish to pursue a different set of data. There are, at present, two lines of evidence that brain-mind is partly quantum.

First, there is growing and powerful evidence gathered independently over decades that *mind is quantum* seen in aberrant behavior of quantum random number generators, telepathy, and precognition. The publicly available data are confirmed at 7.3 sigma for quantum random number generators and above 6 sigma for telepathy and precognition (7). Are these physically possible? Yes, if mind is quantum, spatial nonlocality allows telepathy and psychokinesis. Temporal nonlocality, less well established, allows precognition (ibid).

Second, a particular interpretation of quantum mechanics was offered by Heisenberg, 1958. The quantum states are *potentia,* hovering ghost like between an idea and a reality. We here adopt Heisenberg's view (8). *Reality consists in ontologically real Possibles, Res potentia, and ontologically real Actuals Res extensa, linked by measurement.*This interpretation explains at least 5 mysteries of quantum mechanics, including nonlocality, which way information, null measurement, and "*no facts of the matter between measurements*", (9) so may rightly be considered seriously. *This is not a substance dualism so does not inherit the mind body problem arising due to a substance dualism, (10). Thus, the hypothesis that brain mind is partly quantum makes a new prediction: It suggests a natural role for mind: Mind actualizes quantum potentia. (*4) Mind collapses the wave function, as von Neumann, Wigner and Shimony hoped (11,12,13).

Remarkably, this testable hypothesis stands quite well confirmed. Radin and others have shown at 5.2 sigma across 28 experiments that a human can *try* to alter the outcome of the two slit experiment and succeed. 5.2 sigma is one in 50,000,000, substantially strong but not yet strong enough, (7). If very strongly confirmed, *responsible free will is not ruled out* (7). *This result, if strongly confirmed, alters the foundations of quantum mechanics* (7,11,12,13).

V. **We try to and do collapse the wave function to a single state. We experience that state as a qualia.**

The evidence for quantum aspects of mind and our capacity to play a role in "collapsing" or actualizing the wave function, invites a new hypothesis for how we *see affordances*that we cannot see as classical systems including classical Universal Turing Machines. **Our Brain-Mind entangles with the world in a vast superposition. We *try to and do collapse the wave function to a single state. We experience that state as a qualia*.** Qualia! Why not?

At least three further lines of evidence support the hypothesis just above that qualia are associated with collapse of the wave function.

First, as D. Chalmers points out (14), qualia are never superpositions. Chalmers suggests from this that consciousness plays some role in the collapse of the wave function. We agree.

Second, finding novel affordances is not deductive.*Collapse of the wave function is also not deductive. Our experienced qualia are not deductions.*Neither need ideas that pop into mind when the Muse calls be deductions. Sudden insight gained upon grasping the point of a metaphor is also not a deduction. Insight in doing mathematics is not deductive (15). Creativity is not deductive, it is insight (16).

Third, our analysis of the incapacity of universal turning machines and any classical system to see affordances has a further implication. The evolution of the biosphere with *zombie organisms* can only find new affordances by accidentally stumbling upon them and seizing them by heritable variation and natural selection. It works but *is slow.*

In stunning contrast, sentient organisms can literally perceive, "*search and see"* (1) affordances, are responsible and free-willed, and with preference and emotion choose to act to use them. Watch a cat and mouse near a low chest of drawers. The chest affords the mouse a hiding place. The chest threatens the cat with mouse escape. We do this all the time. So did *T. rex*.

The resulting selective advantage of mind rapidly seeing affordances via experienced qualia due to mind actualizing quantum potentia and free will choosing and acting is enormous. Mind evolved with diversifying life and played a large role the evolution of life that was far more rapid than were organisms philosophic zombies. Niche construction is at least one major area in evolutionary biology in which purposive behavior plays a major role (17,18).

VI. **Relation to Established Neurodynamics.**

The classical brain is dynamically critical (edge of chaos (19). Genetic regulatory networks are critical. (20,21,22) Criticality is magical classically with small stable attractors, maximum entropy transfer, monotonic increase in basin entropy with the number of variables, N and graceful evolution under change of connections and logic (23,24,25). Life is co-evolving self-constructing Kantian Wholes dynamically on the Edge of Chaos (26,27). Co-evolving organisms may co-evolve to mutual criticality to maximize diversity of coordinated activities, (28).

Years of superb work in neuroscience models suggests an astonishing diversity of brain dynamics – perceptual behaviors with a variety of non-linear mathematical models (29). These models are entirely classical physics. If the claim that no classical system can

constitute an analog model for novel affordances is correct, as we claim, then a new pathway to investigate is the possibility of extending classical dynamical models to Hilbert space and seek homologous quantum behaviors.

Such homologous behavior may be possible: For example: can Brain mind be partly quantum and dynamically critical? Maybe with more specific hypotheses: *Quantum scars* (30): The wave function remains in the vicinity of the classical attractor. Does the wave function of a quantum/classical critical brain remain in the vicinity of classical critical attractors that are usually taken to store alternative content addressable "memories"? In this quantum case, repeated actualizations could create highly similar qualia. In short, can such quantum systems inherit the magic of classical critical systems? Perhaps. Very recently a formalism to study quantum Boolean networks has been published (36). More generally, can we seek a mapping from well-studied classical neuro-dynamics to quantum models with homologous behaviors? It should be possible to study quantum analogs of quantum criticality and chaos without and with decoherence (34, 35).

VII. **Possible Soft Matter Systems to Examine and Trans-Turing Systems.**

At present enormous effort is focused on quantum computers that must maintain quantum coherence until decoherence or measurement achieves a solution, often the minimum of a complex classical potential, representing the solution, then computation stops. (31). Cells do not stop. There is abundant evidence for quantum biology (32,33,34). Work in the past half decade has explored a Poised Realm hovering reversibly between quantum and classical behavior (34, 35). Small molecules, peptides and proteins at room temperature can be quantum ordered, critical or chaotic. Quantum criticality lies at the metal insulator transition. Such systems have delocalized wave functions, conduct electrons very well, and have power law slow decoherence that may underlie quantum effects in biology (34, 35). The Schrodinger equation does not propagate unitarily in the presence of decoherence (34, 35).

Intracellular and intercellular protein - protein complexes may constitute such a new class of soft matter and can be studied with molecular dynamics and Lattice Boltzmann methods for quantum and classical behaviors (37). More such soft matter systems might constitute Trans-Turing-Systems" with their own new internal dynamical behaviors and receiving and outputting quantum, classical and poised realm variables (34, 35). Living cells may be Trans-Turing- Systems (ibid).

VIII. **Conclusion**

The hypothesis that qualia are the experience of the actualized wave function, even if sensible, raises major issues: Are all actualizations of quantum superpositions associated with qualia in some form of panpsychism? Does the Strong Free Will Theorem bear on this issue? (38). When a human is in a coma or dreamless sleep, are there qualia? What is unconscious mind from whence the muse? How could we possibly test the hypothesis?

Moral: Artificial Intelligence is wonderful, but algorithmic. We are not algorithmic. Mind is almost certainly quantum, and it is a plausible hypothesis that we collapse the wave function, and thereby perceive affordances as qualia and seize them by preferring, choosing and acting to do so. We, with our minds, play an active role in evolution. The complexity of mind can have evolved with and furthered the complexity of life. At last, since Descartes' lost his Res Cogitans, Mind can act in the world.

Free at last.

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